

Track reconstruction efficiency

A. Rakitin

Lancaster University

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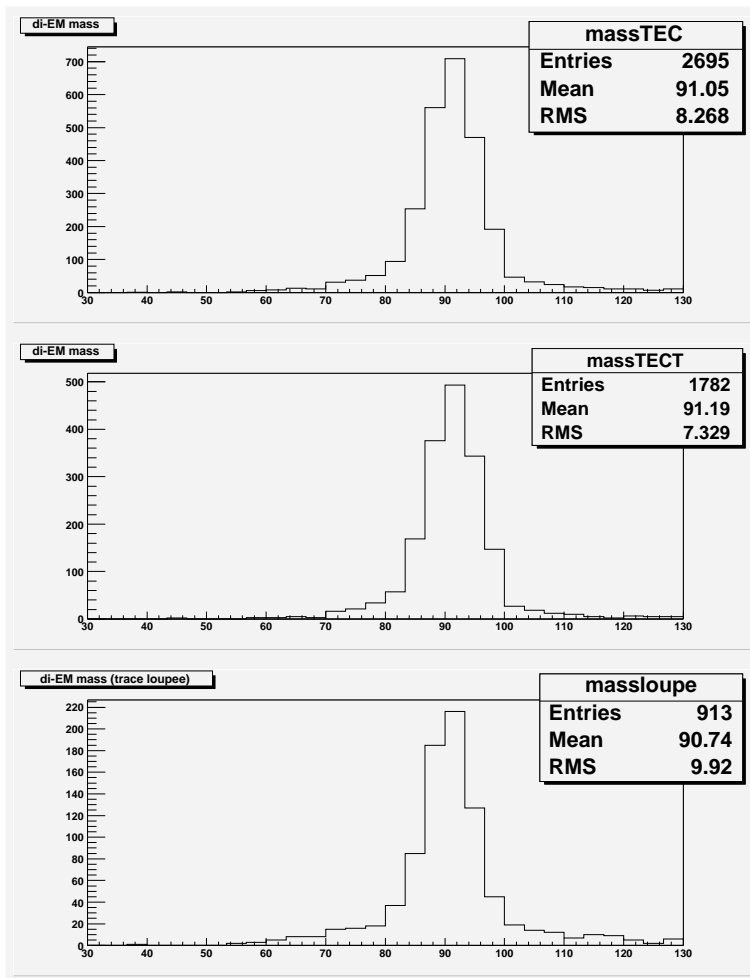
http://www-d0.fnal.gov/~rakitin/d0_private/tex/2006.May.04.Tralgo/tr.pdf



Tracking efficiency study:

Reminder: I use Jan Stark's data sample $Z \rightarrow e^+e^-$:

- One EM cluster in CC ("tag electron") – must have matching track
- Another EM cluster in end-caps ("probe electron") – does not have to have matching track



The plots of di-EM mass (© Jan Stark):

- Upper: all events
- Middle: probe electron has matching track (~66%)
- Lower: probe electron has no matching track (~34%)

- **Problem:** matching track isn't reconstructed for probe electron in one-third of cases
- **Resolution:** slight change of reconstruction algorithm may help

Method of study:

- Shoot an imaginary track from PV to EM cluster
- See which hits are close to it
- Understand why they were not composed into track

In my study I only use first 44 events from the sample in the lower plot



Updates since the last talk



- Idea: allow tracks to have hits in both SMT and SMTD
- Code has to be changed in many places
- One important change was missing
 - SMT tracks were checked for match in z only
 - SMTD tracks were checked for match in r only
 - Combination must be checked for both matches
- ⇒ made sure it is so
- Also, increased 3σ window around track up to 4σ
- As a result, a few more tracks reconstructed (see numbers on the next page)
- Those tracks which still have “hits too far” are $\sim 10\sigma$ away ⇒ errors on the hit positions underestimated?
- No update on timing studies

Reminder of proposed change in algorithm:

- All the tracks having 3+ hits in SMT Barrels are reconstructed with current algorithm
- Non-reconstructed tracks (44) can be divided into 5 categories:
 - ➡ Tracks with
 - either 2 hits in SMT barrels and 1-2 in F-disks
 - or 1-2 hit in SMT barrels and 2 in F-disks
 - (15 tracks out of 44)
 - ➡ Tracks with 2 hits in SMT and 4+ in CFT (8 out of 44)
 - ➡ Tracks with hits being further than “standard” 4σ window (0 out of 44)
 - ➡ “Invalid” tracks with too few axial or stereo hits (5 out of 44)
 - ➡ Tracks with too few hits to be reconstructed (16 out of 44)

By changing tracking algorithm we can reconstruct first three categories



Results



- ➡ Changed algorithm found 8 more tracks in sample of 44 events
⇒ tracking inefficiency decreased by 18%
- ➡ Improvement with respect to last reported number 13%

“2+1” or “1+2” or more SMT hits:

Run/Event	Electron	SMT Barrels	CFT	SMT F	SMT H	Reconstructed?	Reconstructible?
164605 10233199	Probe Tag	2 6	3 7	2 0	0 0	YES Yes	Yes Yes
165805 2576564	Probe Tag	2 0	2 7	2 1	0 0	YES Yes	Yes Yes
166113 39215346	Probe Tag	1 4	3 8	2 1	0 0	YES Yes	Yes Yes
166295 20638511	Probe Tag	1 3	0 8	2 0	1 0	No, invalid Yes	??? Yes
166302 24938931	Probe Tag	1 3	3 8	2 0	0 0	No, hits too far Yes	??? Yes
166302 24109618	Probe Tag	1 4	3 8	2 0	0 0	YES Yes	Yes Yes
164445 2159216	Probe Tag	1 2	2 8	2 2	0 0	No, invalid Yes	??? Yes
166782 123665141	Probe Tag	1 3	3 8	2 0	0 0	YES Yes	Yes Yes
164605 7263701	Probe Tag	1 2	3 8	3 0	0 0	No, hits too far Yes	??? Yes
164041 21879237	Probe Tag	0 2	0 8	2 1	2 0	YES Yes	Yes Yes
166835 18381547	Probe Tag	2 4	1 8	2 0	0 0	No, hits too far Yes	??? Yes
166937 9714345	Probe Tag	2	2	2	0	No, hits too far Yes	??? Yes
167325 3178494	Probe Tag	1	1	2	0	No, hits too far Yes	??? Yes
168498 519484	Probe Tag	1	2	2	0	No, hits too far Yes	??? Yes
168973 5391969	Probe Tag	2	2	1	0	No, hits too far Yes	??? Yes

2 SMT hits and 4+ CFT hits (not investigated yet):

Run/Event	Electron	SMT Barrels	CFT	SMT F	SMT H	Reconstructed?	Reconstructible?
165977 6659303	Probe	2	4	0	0	No, 3-hit req.	Yes?
	Tag	0	5	0	0	Yes	Yes
164385 4847391	Probe	0	4	2	0	No, 3-hit req.	Yes?
	Tag	3	8	0	0	Yes	Yes
166313 32787929	Probe	2	8	0	0	No, 3-hit req.	Yes?
	Tag	0	4	2	0	Yes	Yes
163171 48542536	Probe	1	4	1	0	No, 3-hit req.	Yes?
	Tag	0	8	0	0	Yes	Yes
163171 46651698	Probe	0	4	2	0	No, 3-hit req.	Yes?
	Tag	1	8	0	0	Yes	Yes
164039 14995544	Probe	0	6	2	0	No, 3-hit req.	Yes?
	Tag	3	8	0	0	Yes	Yes
166869 37137074	Probe	0	5	2	0	No, 3-hit req.	Yes?
	Tag	0	8	1	0	Yes	Yes
166868 36065427	Probe	1	4	1	0	No, 3-hit req.	Yes?
	Tag	3	8	0	0	Yes	Yes

Invalid tracks:

Run/Event	Electron	SMT Barrels	CFT	SMT F	SMT H	Reconstructed?	Reconstructible?
164216 83479647	Probe	0	1	3	0	No, invalid	???
	Tag	1	7	0	0	Yes	Yes
164018 11142735	Probe	0	1	4	0	No, invalid	???
	Tag	3	8	1	0	Yes	Yes
164040 18660971	Probe	4	5	0	0	YES	Yes
	Tag	2	8	0	0	Yes	Yes
164083 35308948	Probe	0	0	2	1	No, invalid	???
	Tag	1	8	0	0	Yes	Yes
168525 19495531	Probe	4	5	1	0	YES	Yes
	Tag					Yes	Yes

Run/Event	Electron	SMT Barrels	CFT	SMT F	SMT H	Reconstructed?	Reconstructible?
165645 5273011	Probe	2	2	0	0	No	No, too few hits
	Tag	3	7	0	0	Yes	Yes
164636 16204878	Probe	0	0	2	0	No	No, too few hits
	Tag	0	8	1	0	Yes	Yes
165765 36883677	Probe	0	3	1	0	No	No, too few hits
	Tag	3	8	0	0	Yes	Yes
165686 45005141	Probe	0	2	1	0	No	No, too few hits
	Tag	2	8	1	0	Yes	Yes
164382 3507437	Probe	0	2	0	0	No	No, too few hits
	Tag	0	7	0	0	Yes	Yes
166483 3946198	Probe	0	0	0	1	No	No, too few hits
	Tag	0	7	0	0	Yes	Yes
166505 40748533	Probe	0	0	0	1	No	No, too few hits
	Tag	0	8	1	0	Yes	Yes
163172 49593518	Probe	0	0	1	1	No	No, too few hits
	Tag	0	7	0	0	Yes	Yes
166776 115353883	Probe	0	0	0	0	No	No, too few hits
	Tag	0	8	0	0	Yes	Yes
164605 6649931	Probe	0	0	1	1	No	No, too few hits
	Tag	0	8	0	0	Yes	Yes
164080 30329930	Probe	0	7	1	0	No	No, too few hits
	Tag	1	5	0	0	Yes	Yes
164080 30329930	Probe	0	7	1	0	No	No, too few hits
	Tag	1	5	0	0	Yes	Yes
164095 44036204	Probe	0	1	1	0	No	No, too few hits
	Tag	4	8	1	0	Yes	Yes
166872 41058810	Probe	0	5	1	0	No	No, too few hits
	Tag	2	8	0	0	Yes	Yes
166898 16826502	Probe	0	3	2	0	No	No, too few hits
	Tag	1	8	0	0	Yes	Yes
168732 17138782	Probe	0	4	1	0	No	No, too few hits
	Tag					Yes	Yes



Conclusion

Majority of the missing tracks from the “probe” electrons can be reconstructed by slight variations of the algorithm:

- Require 3+ hits in **both** SMT barrels and disks, not only in barrels or only in disks
- **AND** allow hits to be up to 4σ away from the track
 - diminish tracking inefficiency **by 18%**
 - what is better than previously reported 13%
- **Allow for 2 hits in SMT (barrels and disks) if CFT has 4+ hits**
 - \Rightarrow still to be investigated
- **Make sure processing time does not increase too much**
 - \Rightarrow still to be done
 - \Rightarrow last reported increase in processing time is factor of 2 – needs improvement
- ...